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PRODUCING CIGAR TOBACCO IN PENNSYLVANIA

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TOBACCO production in Pennsylvania is limited to two cigar-leaf types—Pennsylvania Seedleaf, or Broadleaf, a filler type; and Pennsylvania Havana Seed, a binder type.

The recommendations here presented—on plant-bed management, cultural practices, manuring and fertilizing, cropping systems, seed selection, curing and handling, packing and fermentation, and disease control—deal chiefly with the filler type, as the binder type is produced on less than 2 percent of the State's acreage of this crop. Lancaster County, the center of the filler area, contains more than 90 percent of the total tobacco acreage of the State.

This bulletin supersedes Farmers' Bulletins Nos. 416, The Production of Cigar-Leaf Tobacco in Pennsylvania, and 1580, Cigar-Tobacco Production in Pennsylvania.

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Producing Cigar Tobacco in Pennsylvania

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Contents

THE only cigar tobaccos now grown in Pennsylvania are the filler and the binder types. Cigar-filler tobacco, commonly known as Pennsylvania Seedleaf, United States type 41,[1] is produced in the southeastern and central parts of the State, in Berks, Chester, Dauphin, Lebanon, Snyder, York, and Lancaster Counties, the last named growing the bulk of the crop.

Type 41 is outstanding in the domestic-filler class. The features that commend it to the cigar trade are its excellent blending combinations with domestic tobaccos as well as with Cuban and Puerto Rican filler. When properly sweated, Pennsylvania Seedleaf is noted for its pleasant aroma and mild flavor. The inferior grades find a ready market in the scrap-mixture and short-filler trades.

[1] The U. S. Department of Agriculture has classified the commercial types of American-grown tobacco, each with a definite type number, so as to avoid the confusion that often arises from the use of various type names in the trade. This classification is being used for statistical purposes and forms a basis for standard tobacco grades.

The binder tobacco, United States type 53, is grown on limited areas in Clinton, Lycoming, and Tioga Counties. It is now used in a decreasing extent for binders, the greater part being bought for scrap smoking or chewing. In 1899 the three counties grew 2,273 acres, but now (1948) produce only 600. As this acreage is less than 2 percent of the State's total of about 39,000, this bulletin does not present an extensive discussion of production methods of type 53.

SOILS SUITABLE FOR TOBACCO

The soils most suitable for cigar-filler production are upland types derived from calcareous materials. Silt loams are preferred, but clay loams and clays on eroded knolls are utilized.

Soil types derived from pure limestone include Duffield, Dunmore, and Hagerstown, of which the Duffield is about four times as extensive as the other two combined. These soils are found in the broad central valley of the filler district and produce the heavy-bodied dark tobacco characteristic of Pennsylvania Seedleaf.

In the less level southwestern area of the district, the so-called Manor, are found soils of impure limestone origin—the Conestoga, Letort, and Pequea series. Because of their more porous subsoil, they produce thinner and lighter tobacco, one approaching the binder type. A similar grade of better quality is grown on Elk loam of the river-terrace soils along the Susquehanna River.

Soils of shale origin are rather widely found in the northern third of Lancaster County and extending into neighboring counties. They lack the organic-matter content of the other types mentioned and they respond more readily to applications of manure, fertilizer, and lime. Classified as Berks shaly silt loam and Penn loam, gravelly loam, and silt loam, they produce tobacco of good quality except in droughty seasons.

The hilly parts of the southern third of the district are represented by Chester and Manor gravelly silt loams. These soils are of igneous origin, and the tobacco produced on them is generally of poorer quality.

PLANT-BED MANAGEMENT

The primary goal in plant-bed management is to maintain a high level of fertility, maximum water-holding capacity, and porous soil structure, a difficult problem on heavy soils.

Summer and Fall Care

The best seedbeds are those that have been used under good management for several years. The soil should be kept fallow by frequent cultivation in summer. The annual heavy coating of manure should be applied as early as August 1 and plowed under to hasten decomposition.

Soil Steaming

Soil steaming for weed and disease control is preferably done in fall to allow the soils to reestablish their normal moisture-holding capacity before seeding time. It is usually desirable to replow before

steaming, as steam and hot water penetration is better in a loose soil. The fertilizer can be broadcast on the surface immediately before steaming. Board frames are sometimes erected along the north side of the bed area to reduce the movement of weed seeds and other debris.

The great reduction in the number of weeds and fungus diseases more than compensates for the cost of steaming. It is questionable whether steaming more than temporarily reduces the number of bacteria, either harmful or beneficial. A temporary reduction is followed by an increase of the beneficial bacteria that decompose organic materials into the soluble nitrates available to the plants.

Boilers of numerous kinds are used for soil steaming, the most common being the portable type. The owner of the outfit furnishes the operator and does the steaming for growers on a custom basis. In 1947 the rate charged was 70 cents per pan.

Figure 1.—Steaming tobacco plant beds. Illustration shows construction of steam pan and method of moving it.

The heavy sheet iron steaming pans (fig. 1) are usually 5½ to 6 feet wide, 8 to 9 feet long, and 6 to 8 inches deep. They are used in either direction in an inverted position, commonly in a pair, and connected with the boiler by steam hose and pipes. After the edges of the pans are forced into the soil by walking on them, soil is banked around low spots and the steam is turned on. A boiler pressure of 125 pounds to the square inch is maintained for 20 minutes, after which the steam is shut off and the pan moved. If the soil is rather moist or partly frozen the pan will "lift." When this happens steaming should not be continued.

Fall steaming has replaced the spring treatment to a great extent, for fall is a time when work is not pressing and the moisture-holding capacity of the soil is greater than in spring. Alternate freezing and thawing in winter helps to disintegrate the baked soil particles and

to restore their natural looseness, mellowness, and water-holding capacity. Spring steaming allows no opportunity for this restoration. It is necessary to avoid contamination of steamed soil with unsteamed soil.

Steaming stimulates the decomposition of organic materials of all types, and for a week or 10 days after treatment ammonia nitrogen is present in quantities that are toxic to young seedlings. The tender roots are destroyed by excess ammonia nitrogen, and the plant may never appear above ground, or, if it does, it will fail to develop and soon die. For this reason, it is imperative that a week elapse between spring steaming and seeding the beds.

Manuring and Fertilizing

Fresh manures containing a large quantity of straw and undigested roughage must be decomposed by bacteria before they will reach their maximum water-retaining capacity. The bacteria, moreover, compete with the young green plants for nitrogen, causing stunting and a yellow color of the seedlings. Fresh manures can be safely used for seedbeds if applied during the previous summer, but spring applications should be made from well-rotted manures or composts (fig. 2).

Horse, steer, or cow manure, in that order, are preferred because of ease of decomposition. Applications of poultry manure may induce an oversupply of nitrogen and result in the production of tender plants susceptible to disease, or may introduce diseases directly. Stable manures are used at rates of 20 to 30 tons per acre. Manures should not be used as top dressings after steaming, as they will introduce weed seeds.

Figure 2.—Uniform stand of seedlings of transplanting size grown with compost manure.

Because of the density of the tobacco seedbed population, it is sometimes thought that a huge quantity of fertilizer is needed. Actually the plants absorb a very small part of their total requirements in the seedling stage, perhaps not more than 5 percent. A complete fertilizer, such as 4–8–12,[2] at 1,000 to 2,000 pounds per acre, equivalent to 1 to 2 pounds per pan area, is adequate. Fall application is preferable, to reduce burning, in which case a mixture omitting nitrogen carriers may be used. For a bed 100 feet long and 9 feet wide (100 square yards) the following application is needed:

Superphosphate, 20 percent, 9 to 18 pounds.
Sulfate of potash, 6 to 12 pounds.

During the growing season if the plants are light green and cease to grow, nitrate of soda may be applied. For a 100-square-yard bed, dissolve 1½ to 3 pounds in at least 5 to 10 gallons of water and sprinkle evenly. Follow immediately with a thorough washing to prevent burning, for the nitrate of soda solution becomes more concentrated as the water evaporates, finally appearing as a white deposit on the leaves.

If fertilizer is applied in spring it should be thoroughly worked into the surface layer. Even so, a reduction of stand is apt to result as compared with fertilizing in fall.

Preparing and Seeding

Preparation of the plant bed may begin as soon as the soil is dry, late in March or early in April. An iron rake or potato fork can be used to break the crust, care being taken to go no deeper than 4 inches. Crush lumps when possible, otherwise rake off the bed, and follow this by one or two light rakings to level the soil. As the light rake marks give some protection to the seeds it is not necessary to smooth the soil.

Some farmers mix the seed with fine soil, apple pomace, ashes, or cottonseed meal and broadcast the dry mixture over the beds. Others stir the proper quantity of seed in a sprinkling can of water and carefully sprinkle the water-seed mixture over the bed, taking care to keep the contents of the can well agitated (fig. 3). Both methods seem equally successful. Instead of dry seed, many farmers "sprout" the seed for a few days and apply it with water. This practice is not recommended, as many young sprouts are broken off or dry up before becoming established. Any method of seeding should be followed by a thorough, gentle watering.

A practice largely abandoned, but one that has merit, is to tamp, or "firm," the soil immediately after seeding. If the soil is not too dry at the time, seedlings can be produced by this method under cloth cover without watering, as the tamping serves to conserve water by establishing contact between the seed and the moist soil particles. The early rate of growth may not be so rapid, but the stand is often better and more uniform, as no dry spots appear in the bed.

The rate of seeding is more often too high than too low. If conditions are favorable and the seed is nearly all viable, one-half ounce of cleaned seed to 100 square yards of bed space will suffice. As it is rarely possible, however, to have optimum conditions in every respect, a safer proportion is three-fourths ounce to 100 square yards.

[2] Percentages, respectively, of nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O).

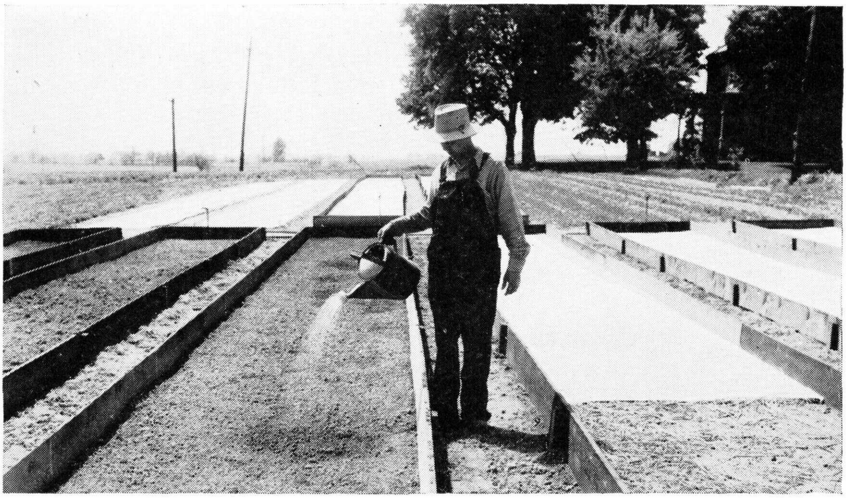

Figure 3.—Wet seeding, using a suspension of seeds in water in the sprinkling can. Cloth covers, with or without boards, and a light mulch of straw used on seedbeds also are shown.

Bed Covers

In most cases, no sideboards are used, but the beds are raised by the addition of soil or by lowering the paths. A light mulch of straw, cotton hulls, or hog bristles is spread over the ground, and muslin is stretched over the mulch and fastened with wire loops to the side of the beds. Boards, when used, have the advantage of preventing weed seeds from blowing into the beds. The use of glass sash permits earlier setting of the plants and aids greatly in the control of bed diseases. Care must be taken, however, to keep the bed temperatures from getting too high, as 95° to 100° F., the safe maximum, is reached by midmorning of a sunny day. More frequent watering also is necessary.

Growing and Pulling the Seedlings

Following seeding, many farmers feel that the beds need no care until the plants are easily visible. On the contrary, the period following seeding is a most critical time, and many of the sprouts on or very near the soil surface may be killed by lack of sufficient moisture during this period. At this stage the plants should be lightly watered twice a day, but later more heavily and less frequently. With cloth covers the natural rainfall may be sufficient to eliminate watering for considerable periods. It also does a more thorough job, wetting the soil to a greater depth and restoring the natural capillary movement of water from deeper soil levels.

Within a month from the seeding date, or early in May, there will be opportunities for lifting the covers during the day, and soon after that they can be entirely removed. Frequent watering of the muslins is a great advantage in producing normal growth, as they reduce sunlight intensity by more than half.

When the plants are 5 to 8 inches high they are ready for transplanting. The bed must first be thorougly soaked with water, otherwise valuable roots may be lost when the plants are pulled. Each plant should have its small ball of soil attached. As the transplants are pulled, they should be placed in a cool shady location until used. It is not wise to pull more plants than can be set the same day. A thorough sprinkling of the bed, to wash the soil off the leaves and stimulate growth of the remaining plants, should follow pulling.

The first pulling from a bed may be the poorest, as the plants are often more tender than they will be later on. The reduction of stand allows the sunlight to reach the smaller plants, and the consequent rapid depletion of nitrogen aids in developing a less succulent growth.

The heavy and repeated waterings needed for pulling may lead to poor physical condition of the soil in the beds. It is at this point that the practice of long-continued manuring of old beds shows to advantage. Where this practice has been followed the soil remains loose and friable, fewer roots are lost, and the plants continue to have normal color and growth. In the absence of sufficient organic matter, the soil becomes puddled, the plants turn yellow and cease growth, and pulling becomes difficult.

Diseases in the plant bed are discussed in a later section.

CROPPING SYSTEMS

Tobacco growing in the filler district is part of a well-stabilized and widely diversified agriculture. Tobacco is one of the high acre-income crops, but it is not alone in that group—potatoes, tomatoes, and most of the market garden crops compete fairly well on the acre-income basis. The rapid increase in the acreage of these crops has not been accompanied by a decrease in the acreage of tobacco, but rather in that of lower income crops. As a consequence, rotations have been adopted that may involve a succession of crops different from the traditional 4-year rotation of tobacco, wheat, legume hay, and corn, or the 3-year rotation of tobacco, wheat, and hay.

This change in practice has generally benefited tobacco. Experiments now in progress indicate that this crop does better following potatoes and tomatoes than after corn or legumes and grasses. A higher level of fertilization is practiced for most of the vegetable crops, with a consequent enrichment of the soil. The residues of these crops are less abundant and are more easily decomposable than those of corn or hay, both of which factors favor the succeeding tobacco.

The growth of legumes or legume-grass mixtures is advocated because of the need for increased organic matter and nitrogen, but it is strongly urged that tobacco not immediately follow a legume in the rotation. Likewise, field corn is a satisfactory preceding crop for tobacco only if the corn is more liberally fertilized than is the common practice. Liberal use of manure and fertilizer for tobacco following corn is nearly indispensable from a yield and quality standpoint. The use of manure for tobacco following legumes does not result in any marked gain in yield or quality.

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Short rotations, such as tobacco and rye, are found to a limited extent, but the practice of growing tobacco continuously is rarely followed. A 3-year cycle in which natural weeds follow wheat has been used by a few farmers with excellent results.

MANURES

The relative abundance of manure is fostered by the practice of steer feeding and extensive dairy farming. The corn, straw, and hay produced on farms on which this plan is followed is thus used, and much feed is purchased, either grain mixtures or such organic supplements as cottonseed meal, soybean meal, linseed meal, or bran.

For the heavy soils of southeastern Pennsylvania, where rainfall is poorly distributed, the basic need for additions of organic matter is well recognized. This need is supplied in part by plowing under the residues of legumes and grasses and in part by the use of manures. The effectiveness of these practices in relation to tobacco production depends in large part on the degree of decomposition of the organic materials, as in their fresh state they are less retentive of moisture. Fresh manure requires a few weeks to partially decompose. In dry seasons, undecomposed or strawy manure may defeat the purpose for which it is used.

Manure applications are beneficial at several points in the rotation. Sanitary regulations forbid the accumulation of manure on dairy farms, but it may be used as a winter top dressing on hay land. Its use early in spring on land to be plowed permits better utilization of nutrients than storage in open piles. A liberal application of manure to the crop preceding tobacco is doubly beneficial because the availability of nutrients is thus prolonged. The most effective use of strawy manure is as a surface mulch.

If used with fertilizer, 15 tons of stable manure per acre is the most economical rate, but if less is available it is better to cover all the tobacco ground equally. The lower limit of response is 10 tons per acre, while with more than 20 tons the growth of the crop may be too rank and the succeeding wheat is apt to lodge.

Best results have been produced by the application of steer, dairy cow, and horse manure and sewage sludge. The more concentrated poultry and sheep manures should be used in reduced quantity and with allowance of adequate time for decomposition and leaching.

FERTILIZERS

Primary nutrient requirements of the tobacco plant include at least 10 mineral elements. Not all of these, however, need be deliberately added to the fertilizer mixture. The soil in the filler district is already well supplied with calcium and magnesium. Therefore, liming produces no crop response but may lead to increased difficulty from tobacco black root rot. Iron and manganese are abundant in soils, and even if limited in solubility by the presence of large quantities of lime they are considered to be present in nearly adequate quantity. Sufficient sulfur is unavoidably added in common carriers of potassium and phosphorus. The need for additions of boron, copper, and zinc has not been established by tests in this area.

The three elements found in all mixed fertilizers—nitrogen, phosphorus, and potassium—are all required for tobacco production in this locality. Most of the nitrogen requirement is met from decomposition of manures and legumes, likewise a fair part of the potassium and phosphorus. Supplementing these two with commercial fertilizer, however, is almost always profitable.

Considerable latitude is allowable in the choice of nitrogen carriers in the tobacco fertilizer. Natural organics, such as cottonseed meal, soybean meal, and tankage; mineral sources, such as nitrate of soda, nitrate of potash, ammonium nitrate, and sulfate of ammonia; and synthetic urea have all performed satisfactorily. Commercial mixtures employ two or more sources of nitrogen—an organic source, to supply about one-third of the requirement; and one or more inorganics, for the remaining two-thirds.

The phosphorus carrier is almost always superphosphate, the grade either 20 or 48 percent phosphoric acid, depending upon the desired analysis.

Potash is almost universally supplied as the sulfate. Other sources of nearly equal value are sulfate of potash-magnesia, nitrate of potash, potassium metaphosphate, carbonate of potash, and cottonhull ashes. Muriate of potash must be avoided because of the deleterious effect of the chlorine on the burning qualities of the leaf.

Quantities and Formulas

Most of the nitrogen in mixed fertilizers is quickly available for supplying the plant needs until the more slowly available nitrogen from manures and organic residues is released. An application of 30 to 40 pounds per acre is sufficient, while without manuring 60 pounds is needed, even following legumes.

The phosphorus content of manure is low, but this factor is offset by its excellent availability. Not more than 80 pounds per acre of the oxide (P_2O_5) is desirable, and even less may be better. Radically increased quantities are actually detrimental to yield and quality. In the absence of manure, about 120 pounds of phosphoric acid is needed unless the soil is already in a high state of fertility.

The problem of potash fertilization is complicated by soil and climatic conditions. Most of the clay soils in the Pennsylvania tobacco area are derived from minerals that are high in potassium but not in a readily available form. If rainfall is uniform and adequate during the growing season, potassium will be released from the minerals and become available to the growing plants. If a drought occurs, however, not only the native potash but also that added in the fertilizer becomes unavailable. Droughts of varying intensity and duration are typical features of Pennsylvania summers, and, as a consequence, tobacco of low potash content is the rule rather than the exception. The best recommendation is an application equivalent to 120 pounds per acre of the oxide (K_2O).

In terms of formula, the recommended analyses are 4–8–12 and 3–9–15 to be applied at 1,000 pounds per acre. Formulas such as 5–10–20 and 3–6–21 require an application of 600 pounds and are used to best advantage where the soil is in a higher state of fertility, except for potash content. The 4–8–12 mixture is most commonly used.

Methods of Application

The efficiency of fertilizers is considerably affected by their placement in the soil. Surface broadcasting of the entire application is not recommended, as the material remains in the upper few inches of soil, the so-called "dust zone," and is thus unavailable to the plant under dry conditions. Potash fixation occurs rapidly and is hastened by the necessary cultivations after rains. A broadcast application of 500 pounds per acre before plowing may be followed by an equal application with the same method shortly before planting. An attachment to the transplanter designed to place the fertilizer in bands along the sides of the row below the level of the plants has resulted in increased yields. Placing fertilizer directly under the plants may cause injury to the roots.

CULTURAL OPERATIONS

Preparing the Field

Spring plowing is customary in the Pennsylvania tobacco district and is usually done in April or early in May. If tobacco follows sod or winter cover crops of rye or ryegrass, earlier plowing is essential to insure decomposition and is advisable in any case. The soil should be prepared by use of a disk harrow, used as frequently as necessary to break the crust and suppress weeds until planting time. Much labor later in the season is avoided by clean cultivation during the preplanting period. A cultipacker attached to the disk harrow leaves the soil in shallow rounded ridges and decreases the drifting tendency that follows flat rolling.

A few days before planting, the soil is worked with a spike-tooth harrow, usually in both directions. This operation produces a loose soil surface, free of lumps and ridges. In order to follow the planter mark, it may be necessary to smooth the soil by a plank or drag attached to a light harrow.

Transplanting and Resetting

While the several makes of transplanters used in this area vary in the position of the essential units, all makes employ a tank for water, with an arrangement for delivering a small quantity at regular intervals, and a mechanism for opening a furrow for the plants, all mounted on a chassis. The machine has a pair of large open-center wheels from which the power to operate the water mechanism is derived. A small broad wheel, centrally located in front, serves to balance the machine and also packs the soil ahead of the planting shoe. Two men ride on low seats on either side of the planter shoe and alternate in placing the plants in the furrow.

The art of setting tobacco would appear easy, but it is not. The work of a well-trained crew is evident in straight rows and in the uniform spacing and upright position of the plants. To achieve this the plants must be uniform in size, free of excess soil, straight, and well packed in the boxes. In setting, the plant is held by the upper

leaves in a position between the sides of the shoe and near the water outlet. The click of a trip mechanism indicates the delivery of the water, usually a half a cupful, and the plant is lowered into the furrow and held upright as the machine moves forward, being released when the soil drops around it at the back of the shoe.

Planting distances are relatively standardized, with the rows 36 to 40 inches apart and the plants 24 to 28 inches in the row. A spacing of 26 inches in the rows and 40 inches between rows provides 6,000 plants per acre. Within reasonable limits, departures from this number do not affect total yields. An increase in soil fertility will permit setting a somewhat larger number of plants, but too close setting makes cultivation difficult. More widely spaced plants will grow to a greater individual size, but this may be a disadvantage in harvesting and curing.

The Pennsylvania district is fortunate in having a long growing season, thus making it possible to plant tobacco from early in May to early in July. It is rare, however, for tobacco set at the extreme dates to be as good as the medium-set crop. The very early tobacco may be favored by rainfall, but it is often a thin papery crop and may cure under too hot and dry conditions. The very late tobacco matures with much difficulty, owing to low temperatures, and cures in adverse weather and may even freeze in the field or shed. It is attacked by all the insect pests migrating from the earlier cut fields. A planting schedule running from June 1 to June 20 is the happy medium over a period of years.

Restocking is done following heavy rains, which obviates the necessity of watering. It should not be neglected, as missing plants decrease the yield per acre. Opportunities to restock are usually available for all but the latest plantings. Early resetting allows more uniform growth and less work in topping and suckering.

Cultivation

To break the crust near the young plants and kill weeds, cultivation should be begun soon after transplanting and should be continued as long as the cultivator will pass through the row without damaging the leaves. In the first cultivation the shovels may be brought near the plants, and as the plants grow they may be moved farther away. It is most important to cultivate after every rain that is sufficient to form a soil crust.

A mechanical hoeing device, consisting of a pair of very narrow cultivator shovels mounted on swivel arms, is commonly used for cultivating. The operator, seated behind the cultivating machine, moves the hoes back and forth, bringing them together between the plants and separating them as he passes a plant. This device is effective in reducing the labor of the hand-hoeing that follows.

Common Weeds and Their Control

In addition to a wide variety of native field weeds present in Pennsylvania, additional species have been introduced with legume, grass, and grain seeds. The weed population is further increased by the use

of manure containing seeds and likewise by a preceding poor stand of hay. Following is a list of important weeds, including grasses:

Annuals:	
Green pigweed	*Amaranthus retroflexus*
Lambsquarters	*Chenopodium album*
Indian mallow	*Abutilon theophrasti*
Smartweed	*Polygonum hydropiper*
Green foxtail	*Setaria viridis*
Crabgrass	*Digitaria sanguinalis*
Barnyard grass	*Echinochloa crusgalli*
Biennial:	
Burdock	*Arctium minus*
Perennials:	
Sowthistle	*Sonchus arvensis*
Field bindweed	*Convolvolus arvensis*
Plantain	*Plantago major*
Quackgrass	*Agropyron repens*

Clean culture of the fields in the period between plowing and planting, several cultivations during the growing season, the use of the mechanical hoer previously described, and one or two hand-hoeings will insure weed control. Thistles have deep taproots and therefore often escape removal during cultivation. They require several careful hand-hoeings before their food reserves are exhausted. Field bindweed, if allowed to remain until the tobacco is harvested, will damage many leaves through tearing. Quackgrass presents a serious problem, and its control requires bare culture for a season. The competition of weeds with tobacco plants for nutrients, moisture, and light, as well as the increased labor necessary for crop production, are sufficient reasons for adopting efficient practices for weed control.

Topping and Suckering

The removal of floral parts and the upper part of the stalk is known as topping. This operation causes a profound change in the activity of the plant. An untopped plant will continue to grow in height, producing seedstalks bearing flowers and seed pods, lower leaves that ripen normally, but upper leaves that will be progressively less ripe. From the time of topping, the leaves remaining on the stalk enlarge in width and length and become thicker and less pliable. Ripening is the first step in the death of the plant, and all subsequent cultural operations are designed to regulate and control this process.

It is the aim of the tobacco grower to have all the leaves ripen at nearly the same time. Climatic conditions and the level of fertility determine the number of nearly uniform leaves that can be produced. If the soil is in a high state of fertility and growing conditions have been favorable a larger number of leaves can be left. At successively lower levels of fertility fewer leaves will fully develop. It is safer with late tobacco or during dry years to top low. No more than 16 leaves should be left under the best conditions, 13 to 14 under less favorable or average, and 10 to 12 under adverse conditions.

Topping a plant results in an unbalanced condition between the top growth and roots. This manifests itself in the development of suckers, which are branches growing out of the axils of the leaves. The use by the suckers of the nitrogen and mineral elements furnished by the roots permits the leaves to ripen. Some farmers remove suckers only

once before cutting, but suckering twice is perhaps justified if the growth is profuse, for if the suckers get too large, there is danger of breaking or tearing the leaves. Suckers should never be allowed to remain on the plants when harvested, as they interfere with proper curing. Some may develop in the shed, especially if the stalks remain green for some time.

Harvesting

Within 3 or 4 weeks after topping, the plants are ready to harvest. The most reliable indications of ripeness are the paler green color of the leaves; their mottled appearance and increased thickness; and their increased brittleness, as detected by the ease with which the leaf tissue breaks. If they are fully ripe these signs are apparent on the top leaves as well as on the normally more mature lower leaves. The normal harvesting season is from August 20 to September 20.

Long-handled shears are used to cut stalks. Cutting is usually begun about noon, when the plants are dry, and is confined to clear weather, as the plants will not wilt properly under cloudy or rainy conditions. Usually about an hour suffices to wilt the plants, but less time should elapse on very bright calm days, otherwise sunscalding will occur. The scalded parts soon turn black in curing and are of inferior quality.

The plants are strung on 4-foot hardwood laths having an iron spear point slipped on the upper end (fig. 4). The other end is placed on the ground and the stalk is balanced on the spear point about 5 inches from the butt. A quick downward thrust forces the point through the stalk, which is then pushed along the lath to such a position that five or six plants are strung on each. The strung laths are then placed in rows on the ground, ready to be loaded on wagons fitted with racks, which hold about 100 laths. In the shed the laths are passed upward to workmen who place them on the poles. A spacing of not less than 8 inches is necessary to prevent shed damage.

SEED SELECTION AND SEEDLEAF STRAINS

Every farmer has the opportunity to improve his strain of tobacco by careful selection of seedstalks. Plants of desirable type can be selected in the field before topping, care being taken to choose plants of good growth and uniform type. The points to be considered are number of leaves, shape (including width), type of tip, width of heel, space between leaves, habit of growth—drooping or upright—and production of suckers.

Remove the upper leaves and side branches, leaving the umbrella-like top, which contains the seed pods (fig. 5). The seed head should be covered with a paper or muslin bag to prevent accidental crossing by insects. Loosen this bag from time to time and push it upward as the flower head grows. When the pods turn brown cut off the upper part of the stalk and hang it in the shed in a place safe from rats and mice. After drying, the seeds are shelled, screened, and subjected to an air current to remove chaff, dirt, and light seeds. Seed should be thorougly dry when stored; placed in reasonably tight containers, such as glass jars without rubbers; and stored in a moderately cool, dry room.

Figure 4.—Spearing plants on 4-foot lath.

The common strains of Pennsylvania Seedleaf, including farmers' selections, are numerous. Comparative tests indicate considerable differences in growth habit, yield, and quality. A few outstanding strains are briefly mentioned.

Swarr-Hibshman has been consistently high yielding, with rather wide leaves, narrow at the heel, and well placed on the stalk (fig. 5). The resistance to black root rot is high.

Greider is likewise a high yielder, with slightly narrower leaves and good growth habit. It yields a high percentage of wrappers, owing to the outstanding quality of the lower leaves.

Connecticut Broadloaf is a direct importation from the State for which named and has become acclimated to Pennsylvania. It retains many of its original characteristics, broad leaves, drooping habit,

Figure 5.—Tobacco plant, of Swarr-Hibshman variety, selected for seed.

rather close placement, and rapid maturity. The yield and quality are high, the leaves being thin, elastic, and light in color.

Among the farmers' selections, Heilman and Zanders have been the best. Both strains grow vigorously, have good leaf shape and growth habit, and produce a high percentage of wrappers.

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Some commonly grown strains have failed for various reasons. The much-favored Swarr is notably susceptible to black root rot, hence makes a poor early growth and, unless late conditions are favorable, a low yield.

Red Rose, a leading strain in the eastern half of the district, produces a rough leaf, consequently low grading, while the yield is affected by black root rot.

Slaughter has too broad a leaf, especially at the base, and consequently is more susceptible to shed burn.

CURING [3]

Loss of more than 80 percent of green weight is the most striking feature of curing, but it is not the only change that occurs. The chemical break-down that has started in the field continues at an increased rate under favorable curing conditions. The problem of shed curing of stalk-cut cigar tobacco is primarily a matter of balancing the two processes, allowing neither to proceed at either too rapid or too slow a rate.

Under favorable conditions of temperature and humidity, ripe tobacco will lose about half its green weight in 2 weeks. If this rate is not maintained, damage from shed burn may occur. If the rate of curing is markedly increased, drying will proceed at a rate that does not allow proportionate chemical break-down, and lifeless greenish (or yellowish) colored leaves will be produced.

At the end of 2 weeks, all but the top leaves should be turning color, reddish or medium browns predominating. As curing proceeds, all leaf tissue will become brown, followed by a drying of the midribs, only the stalk remaining with little change. If tobacco is unripe, usually true of late tobacco crops, no amount of regulation will produce a light-colored product.

Most of the tobacco produced in Pennsylvania is cured in the large barns that are so prominent a feature of the rural scene. These barns contain other farm products, such as hay, straw, grain, and feed; while cattle, horses, pigs, and chickens also may be housed under the same roof. Few of the barns are designed with more than a passing thought to their use for tobacco curing. Ventilators are few and of inadequate size. As a result, it is largely due to fortunate curing weather that losses from house burn (shed burn, pole sweat, smothering, etc.) are not greater. In the wet curing season of 1942 at least one-third of the crop was entirely lost from this one malady.

Methods of Controlled Curing

Under the prevailing conditions, the use of frames, or "scaffolds," to permit partial curing outdoors is highly desirable (fig. 6). During the week or 10 days that the tobacco remains out in the open a large part of the necessary loss of water and much of the chemical changes occur, and then shed curing becomes a less critical problem.

Adequate spacing of the lath on the poles should not be neglected.

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[3] See also Tobacco Curing, by W. W. Garner, Farmers' Bulletin 523 (revised by James E. McMurtney, Jr., 1947).

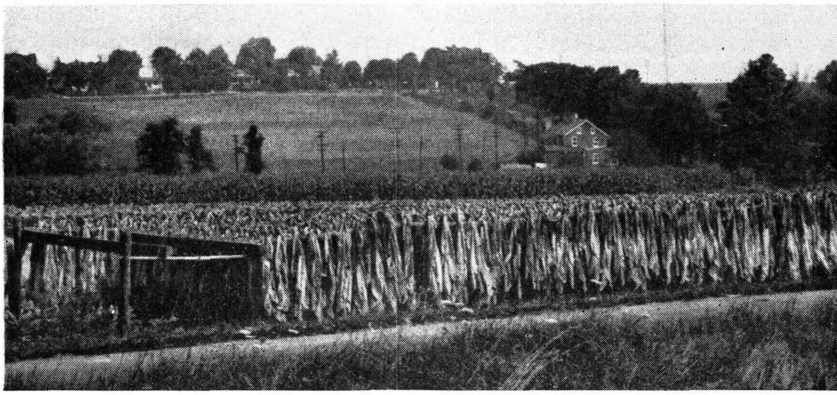

Figure 6.—Partial field curing on a frame, or "scaffold."

Less than 8 inches of space between laths is never safe, as the tobacco leaves regain moisture under humid conditions, causing "strutting." The leaves from plants on adjacent laths then touch each other, creating ideal conditions for shed burn. If the plants are large, one less plant per lath is desirable.

Shed ventilation, provided the building is equipped with ventilators, can be employed to improve curing to a marked degree. The proper procedure, however, does not consist of opening the ventilators when the shed is full and leaving them open until the crop is cured. If the days are fair and calm and the nights moist, the shed may be opened in the morning and closed at night. On dry, windy days too rapid loss of moisture will occur with the shed entirely open, also there will be breakage of the leaves. Under such conditions, a few ventilators on the still side should be opened. During damp or rainy weather the shed should remain entirely closed, but the earliest opportunity should be taken to open the ventilators and thoroughly air the shed.

Experiments at the Pennsylvania Tobacco Experimental Laboratory have demonstrated the value of induced air movement in the shed. Blowers driven by 1/3-horsepower motors, placed at intervals of 18 feet in the shed, force the air upward through passages in the tobacco. Continuous operation of the blowers removes free water from the surface of the leaves, and no shed burn damage has occurred. In the section without air movement, and in many farmers' sheds, severe loss has been common.

Small stoves, or "salamanders," employing coke as a fuel, are sometimes used for drying tobacco.

The most effective method of hastening curing, however, is by the use of small fires. Unfortunately, this method cannot be employed in barns containing hay and straw, because of the risk from fire; neither can it be used with entire safety in sheds with wooden floors. If used in a shed with a dirt floor a large number of small holes may be dug, at least one per 75 square feet of floor space. These holes are filled with charcoal.

These open charcoal fires should be protected by a screen-wire cover supported by metal frames so that no falling tobacco or other flammable material could come in contact with the open fire. These screens can be removed when it is necessary to replenish the fuel.

Charcoal fires will give off carbon monoxide gas in heavy quantities. Workers should be careful to ventilate the building before entering to work.

A temperature of 10° to 15° F. above outdoor readings should be maintained until the tips of the leaves are dry throughout the entire shed. This usually requires 24 to 48 hours. Firing should be started after 1 day of humid weather, certainly before the characteristic symptom of "strutting" occurs, and before a foul, offensive odor is noted in the shed.

The tobacco in the upper part of the shed must be well dried. It will suffer greatly by partial firing, which merely drives the moisture off the lower tiers and condenses it in the peak. Ridge ventilators, of the circular type or of the continuous false-roof type, are needed to allow escape of the hot moist air.

STRIPPING, GRADING, AND BALING

Stripping the crop is the winter occupation of the tobacco farmer. By Thanksgiving time other field work is complete, and from then until early March the farmer will be found in the stripping cellar. The tobacco is removed from the curing shed and hung in a damp cellar for several days before stripping. Both cellars are beneath the curing shed, thus permitting the handling of dry tobacco from the shed. Damp periods that permit removal of the tobacco cured in barns also occur frequently. This permits the tobacco to be piled on the floor of the barn or on a platform in the damp cellar.

If the piles dry out too much to permit handling, the butts of the stalks may be carefully sprayed to remoisten the leaves before handling. Excessive use of water in this operation may cause water stains, and if the crop is subsequently packed too wet, black rot or "must." Tobacco that remains in the dampening cellar too long is subject to the same disorders.

When the tobacco is in the proper "order" (sufficiently moist condition to handle without breaking), the laths are brought into the stripping room and the stalks removed from them. The lower leaves are removed, also any damaged leaves from the middle or upper part of the plant. These leaves are inferior in quality, being pale and lifeless, and are tied into hands without grading for length. Locally (Lancaster County) they are known as fillers, but their ultimate use is commonly for scrap chewing or smoking grades.

From the remaining leaves on the stalk a few farmers select the lighter colored leaves of thin and silky character for binder purposes. The rest of the leaves are placed in a grade known locally as wrappers. This grade is used by manufacturers for cigar fillers and scrap chewing tobacco.

Following their removal from the stalk, the wrapper leaves are assorted by length, an operation known as sizing. The boxes used contain compartments varying in length from 16 to 32 inches, in 2-inch intervals. The leaves are then tied into hands containing about 15 leaves, a shorter leaf being used as a tier (fig. 7).

The various sizes are not packed separately, all being placed in the same bale. For this purpose, a baling press is used. This is a

Figure 7.—Tying a hand of tobacco.

box with collapsible sides, lined with paper, and equipped with a pressing mechanism. About 70 pounds of tobacco is pressed into a bale, which is then tied with three or four strings, the paper covering all except the butts of the hands. When they are tied, the pressure is released and the bale is stored in a dry place (fig. 8).

Care should always be taken in handling the leaves during grading. The sizing should be accurate and the hands well tied, with no projecting butts. In packing, the leaves should be kept smooth and straight.

Bales should be piled not more than two high, preferably on rails, to permit free air movement. A damp location for storage should be avoided, as the tobacco may rot. On the other hand, if it is allowed to dry excessively, breakage will occur in handling and the tobacco may need to be moistened before packing in cases for fermentation.

MARKETING

The common method of sale of the tobacco crop in Pennsylvania is a direct transaction between farmer and buyer, the sale being made on the farm while stripping is in progress. Early in the year after the one in which the crop was grown a concerted marketing drive is made by representatives of packers and manufacturers, aided by farmer-buyers employed on a commission basis. Often within a few days nearly the entire crop is sold.

Figure 8.—Tying a bale of tobacco—open baling press and mechanism for tightening the bale are shown.

PACKING AND FERMENTATION

Delivery to the warehouse is made shortly after the sale of the crop. Upon arrival, the tobacco is usually stored in unheated rooms until it can be packed, but a few packers heat and humidify their storage rooms, thereby inducing a mild fermentation and equalizing the extremes of moisture content of the tobacco received.

As the first step in packing, the bales are opened and the hands reclassified in lengths and examined for defective and inferior leaves, which are removed. The tobacco is then packed in wooden boxes of 30-inch cross section, varying in length from 33 to 52 inches, according to the length of the leaves to be packed (fig. 9). The sides and the bottom of the case, but not the ends, are lined with heavy, smooth paper.

In packing, the butts are placed toward the ends of the case, the tips of the leaves neatly lapped, with alternate rows of the butts in opposite ends of the case. By means of removable false ends an air space of 1½ inches is left at each end. The tobacco is packed to a height of 12 inches or more above the normal height of the case, removable sideboards being used to hold it in place. It is then subjected to great pressure, which compresses the hands and permits the lid to be nailed in place (fig. 10).

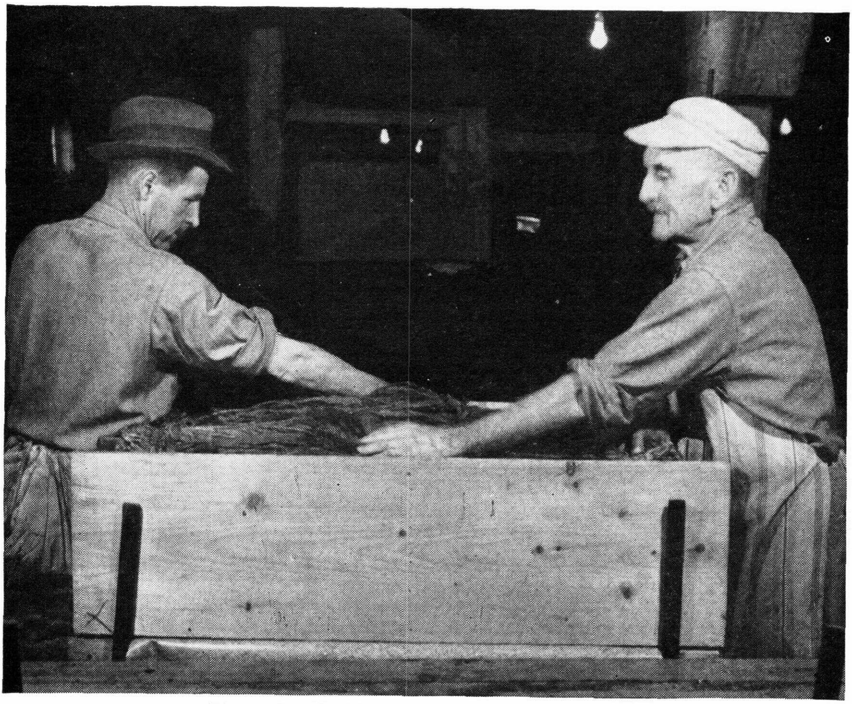

Figure 9.—Packing tobacco hands in the case.

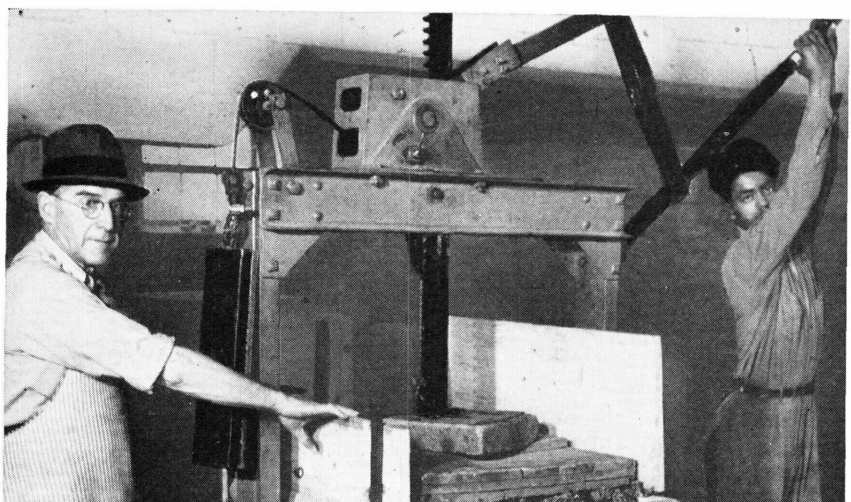

Figure 10.—Final pressing of tobacco leaves.

First Fermentation

The cases remain piled in the warehouses, usually unheated, for several months following packing (fig. 11). During this time, the tobacco undergoes considerable chemical change, which is accelerated by the pressure in the case and the rather high initial moisture content. A rise in temperature of 20° to 30° F. above room temperature occurs shortly after packing, followed by a gradual decrease until the difference is only 1° or so after 3 months in storage.

Two factors combine to slow down the fermentation—the loss of moisture and decrease in the oxygen supply. Minor temperature gains sometimes occur following damp weather.

About the first of October the cases are opened, samples are removed for grading of the packing and for inspection by buyers, and the tobacco is returned to the case for further storage.

The method described above is known as a "natural sweat." In forced sweating, the tobacco is similarly packed in cases, but storage is in rooms that are heated and sometimes humidified. A room temperature of 80° to 100° F. with a humidity of 60 percent greatly accelerates the rate of fermentation. After about a month, the artificial heat is reduced and the process becomes comparable to natural sweating.

Bulk sweating is usually conducted in stemmeries devoted exclusively to the preparation of scrap grades. Large piles of loose leaves, often a blend of several types, are thoroughly moistened with water and allowed to reach a temperature of 135° F. or more. Repiling

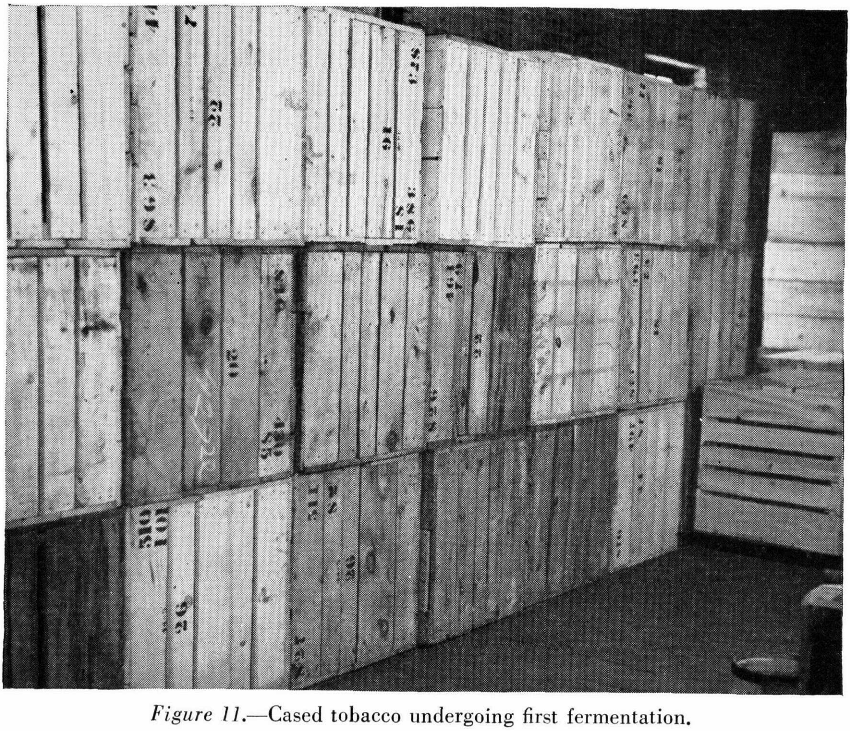

Figure 11.—Cased tobacco undergoing first fermentation.

is done with forks, the tobacco being allowed to ferment until it is quite neutral in taste. A cross section of the entire crop, including wrappers, is now used for scrap chewing and hence is bulk-sweated.

Resweating

Resweating commences with the removal of the tobacco from the cases, a shaking to open the hands, and a complete dipping of the hands in warm water for a minute or so. If the leaves are very dry, the cases are often left in a warm saturated atmosphere for a week or two before opening, to reduce breakage. After dipping, the hands are placed butts down on a drain rack and allowed to remain several hours. The tobacco is then repacked in the original cases, but no attempt is made to apply pressure. Instead, either more cases are employed, or the cases are built up with sideboards.

The sweat rooms are maintained at temperatures in excess of 100° F. and at humidities approaching 70 percent of saturation. From 2 weeks to 9 months is required for resweating, often with several repackings. Variations are due to the chemical composition, age, and physical properties of the crop. Tobacco grown in dry season invariably requires more resweating than wet-season crops. Experts judge completeness of fermentation by the aroma while the tobacco is still hot, the taste on a cigar, and the appearance and feel of the leaf. At the end of the process the leaf is rather tender, only slight tension being required to tear the tissue.

Operations Following Resweating

As a gradual transition from the severe conditions of resweating is desirable, the tobacco may be transferred to small bulks for 10 days to 2 weeks, or it may be left in the cases and stored in rooms in which the temperature is gradually lowered.

The next operation is stemming, which consists of the removal of the midribs, either by hand or by machine. Following stemming, the half leaves are often subjected to alternate dry and moist heat to remove other undesirable constituents.

Nearly all cigars on the market at the present time are machine made. Long fillers, parts of leaves as long as the cigar, are used on many brands. Others employ scrap filler, either small irregular pieces of leaves or the leaves cut into narrow strips or "ribbons."

Effect of Fermentation

The taste of cured but unfermented cigar tobacco is bitter and unpalatable, and the aroma is biting and pungent. The primary purpose of fermentation is to remove the chemical constituents that produce these bad effects and at the same time permit the development of compounds that favor a desirable taste and aroma.

PHYSICAL CHANGES

Cured tobacco still retains a waxy surface coating commonly known as "gum." In the pure state this gum is pale yellow or even colorless,

but under natural conditions it is mixed with soil particles, soot, and grime, and is black. During the first sweat, the gum practically disappears from the leaf surface. The glossy appearance of the leaf is replaced by a duller shade, and the color is somewhat darker, while the flexibility is only slightly reduced. With each manipulation the ease with which the leaf gains or loses moisture is markedly increased. There is some shrinkage in width and length and a loss in dry weight of about 5 percent.

The physical changes in resweating are largely an intensification of earlier changes. The tobacco becomes darker, most of the flexibility, or "stretch," is lost, and the surface is dull and lusterless, while the loss of tensile strength is very marked.

CHEMICAL CHANGES

A very active process involving plant and bacterial enzymes is at work during fermentation. Some enzymes that aided in the curing are probably still active, but in other respects the complex is decidedly different. A marked increase occurs in the number of certain bacteria not active in curing. Lesser numbers and different types of bacteria are found in poorly fermenting tobacco, commonly tobacco produced in dry seasons. The presence of residues from dusting for insect control may reduce the activity of fermentation. During the curing process of stalk-cut tobacco there is a movement of soluble materials from the leafstalk which can no longer occur when the leaves are removed from it.

The losses in the total content of nitrogen fall within the nonprotein group, and there is some evidence that proteins may increase at certain stages of fermentation. As this proceeds, the tobacco tissues become more alkaline, and the loss of ammonia, nicotine, and related compounds is thus assisted. The final operations of alternate drying and moistening at high temperatures cause a sharp drop in the content of such volatile bases and the tobacco again becomes more acid.

The total loss of nicotine during the entire series of operations ranges from 10 to 60 percent of the content before fermentation. Decreases in ammonia content may reach 40 percent, while other volatile bases are lost in lesser proportion.

TOBACCO DISEASES AND INJURIES

The reader is referred to other publications for a more complete discussion of tobacco diseases and their control. [4]

Diseases of the Plant Bed

Three diseases are of major importance in the seedbed—blue mold, wildfire, and mosaic. A fourth disease, "damping off," is much less prevalent since steaming has been introduced. When it does occur, it is readily checked by removing the covers and allowing the beds to dry.

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[4] Blue Mold Control in Tobacco Beds, by E. E. Clayton, U. S. Dept. Agr. Leaflet AIS-37, 1945 (revised 1947).

Tobacco Culture, by W. W. Garner, Farmers' Bulletin 571, 1914 (revised 1936). See also footnote 3, p. 16.

BLUE MOLD

Blue mold,[5] or downy mildew, has become a serious malady within recent years, the earliest marked outbreak being in 1933 (fig. 12). When allowed to spread unchecked it may completely ruin a bed. Less serious outbreaks cause a depletion of stand or at least check the growth of the seedlings and delay setting for a week or longer. In years when the disease is severe, shortages have been sufficient to raise the price of plants more than 100 percent.

The disease is easily recognized, especially in the morning, when the leaves are covered with dew. The leaves have a slightly water-soaked appearance and are distorted in shape, usually with the margins turned down, to form a cupped, puckered, or rolled appearance. The under side has a downy feltlike covering, usually dark bluish to purplish gray. When the leaves are dry it is difficult to detect the presence of this growth, but the diseased tissue soon turns yellow or fades.

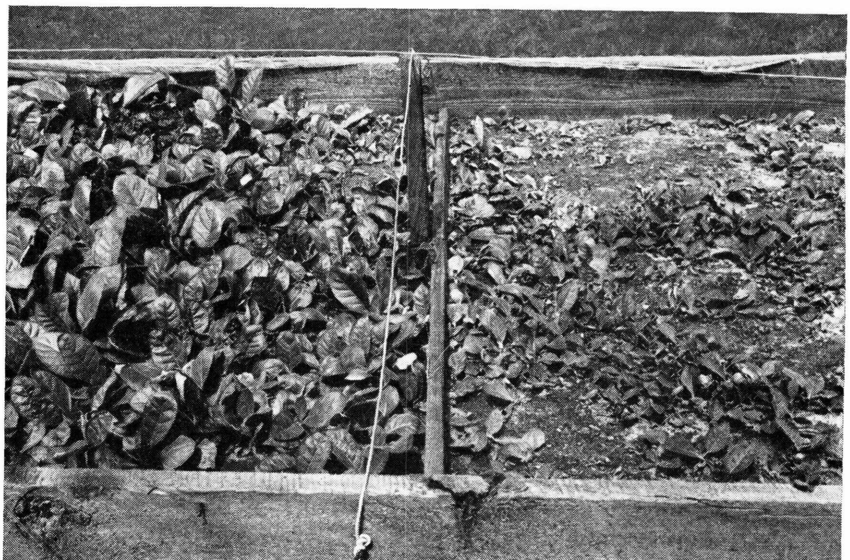

Figure 12.—Blue mold damage in plant bed.

The spread of the disease is favored by damp, misty weather with day temperatures below 75° F. If 85° or higher is reached or the weather is clear and dry, the disease is soon checked. In practically every season, however, there are periods as long as a week when conditions are entirely favorable for the spread of blue mold. The disease is spread by the spores, which are contained in uncounted numbers in the feltlike mass on the leaves and are borne by the wind for great distances. The usual date of appearance of blue mold in Lancaster County is near May 10.

Because of the widespread damage from the disease, many methods of control have been studied. Obviously ventilation and removal of the covers have some preventive value, but it is slight. Bordeaux mix-

[5] Caused by *Peronospora tabacina.*

ture has been tried, but it rarely does more than postpone the attack. The most convenient, effective, and safe material is Fermate.[6]

Both bordeaux mixture and Fermate are highly poisonous substances, particularly in undiluted forms. Persons handling and mixing these substances should exercise great care to prevent breathing or ingesting either the spray or dusts. Mixing should be done either out of doors or in a well-ventilated room. Vessels used in applying dusts or sprays should be thoroughly cleaned before reuse. All residues should be destroyed. Avoid storage of such poisons.

Fermate is a sooty black powder, difficultly soluble in water. When used as a spray twice a week, always beginning before the disease appears, effective control has been obtained. No injury from the proper dosage has occurred, but instead, the growth of the plants has been stimulated. In this section, treatments should begin by May 1.

In using Fermate, mix the dry powder at the rate of 3 pounds per 100 gallons of final solution. First, moisten the desired quantity with a little water in a fruit jar, allow it to stand for a few minutes, and then shake it until all the powder is wetted. Wash the contents of the jar into the spray tank and make up the desired volume. Use within a few hours, do not save overnight, and do not add lime or wetting agents. With the mixture of 3 pounds to 100 gallons, use 10 gallons to 100 square yards of bed space per application. The dark color of the foliage is not detrimental to the plants. Fermate is also fairly effective in dust form, in the proportion of 1½ pounds diluted with 8½ pounds of talc or pyrophyllite, but not lime. Two pounds of the mixture may be applied to 100 square yards of bed space. Repeat the treatment, either spray or dust, at 3- to 4-day intervals from early in May until hot weather checks the disease.

WILDFIRE

Wildfire [7] is considered the major disease problem in the filler district of Pennsylvania. Control measures have been rather ineffective, particularly in wet seasons. When field conditions favor severe damage, plants that were apparently disease-free in the bed will become badly damaged in the field. Under ordinary conditions clean plants are much to be preferred, and for this reason sanitary measures are well repaid. The recommendations here given may not give immunity from wildfire but will help.

1. Dip the muslin, if not new, in a solution of 1 part formaldehyde in 50 parts of water. Some people are much more sensitive to formaldehyde than others. Persons mixing and applying this substance should avoid ingesting either the full-strength or diluted compound. Mixing should be carried on either out of doors or in a well-ventilated room, as the vapors are highly poisonous.

2. If infection of seed is suspected, place in a muslin bag and sterilize by soaking for 15 minutes in a 1-to-1,000 solution of silver nitrate; then wash in running water for 15 minutes and spread in a thin layer to dry quickly. **Silver nitrate is a deadly poison. It is**

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[6] Trade name for ferric dimethyldithiocarbamate.

[7] Caused by *Pseudomonas tabaci*.

irritating to and stains the skin, even in some diluted forms. Persons mixing and applying the compound should use great care to prevent ingesting it and to prevent contact of the mixture with the skin. Avoid storing the original compound.

3. Spray the beds with bordeaux mixture, not stronger than 4–4–50, as soon as the plants appear. Remove the covers to do this, and spray the boards, covers, and soil as well as the plants, at least the first time. Bordeaux mixture is more effective as a disease control and is much less apt to retard plant growth if applied with a high pressure than with a hand sprayer. Either, however, is better than the sprinkling-can method. The home-mixed bordeaux, using burned lime and copper sulfate stock solutions, gives the best results. Repeat the spraying two or three times at weekly intervals. (See caution on use of bordeaux mixture, p. 26.)

4. Keep the beds free of tobacco refuse of any sort, and never use on tobacco beds any poultry manure containing tobacco refuse employed as an insecticide or vermifuge.

MOSAIC

Mosaic [8] (foxy, calico) is a virus disease, which means that it is found in the plant sap in a form that does not permit treatment by any known spray or dust. Control is solely by prevention of infection. As the virus will live in dry tobacco for many years, all refuse or stems should be avoided. Perhaps the most common means of spread is by workmen spitting tobacco juice, handling the plants after chewing, or smoking tobacco, cigarettes, or cigars. Scrap tobacco may contain the infection, as mosaic-infected leaves are often used for this purpose.

As 2 weeks from the time of infection are required for the symptoms to appear, mosaic is rarely seen in the seedbeds. Yet the beds are the principal source of field infection. If mosaic is detected in the bed it is not safe to use the plants. Many more of the plants from an infected area will have the disease in masked form, and the operations of pulling and setting will infect the clean plants. It is necessary to handle only 1 infected plant to get enough virus on the hands to infect the next 20 or 40 plants handled. Washing the hands with soap and water after handling infected plants, and also after handling cured tobacco, is an effective means of preventing the spread of infection in the beds.

Field Diseases

MOSAIC

Mosaic in the field is easily recognized (fig. 13). If the disease is evident on a few individual plants, those showing the symptoms at an early stage should be removed. This will prevent a spread of the disease through cultivation and handling. At topping time it is worth the extra effort to top the diseased plants as a separate operation.

Early mosaic infection is disastrous to yield and quality, the reduc-

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[8] Caused by *Marmor tabaci.*

Figure 13.—Mosaic-infected tobacco plants showing mottled and roughened appearance of leaves.

tion in yield sometimes exceeding one-half, while the wrapper production reaches zero. Later infection causes only the top leaves to develop the characteristic mottled pattern, but the lower leaves may show either small round red spots, known as red rust, or large bleached areas similar to sunscald. Infection through topping causes an indistinct pale mottling of the upper leaves, but typical patterns on the sucker leaves.

WILDFIRE

Wildfire in the field is distinguished by large round yellow spots surrounded by a "halo" of tissue lighter than normal in color (fig. 14). These spots may join, forming large areas of dead tissue, which may break during handling. Under severe conditions the lower leaves may be entirely dried up and lost and the entire plant may take on a reddish appearance, hence the common name rust.

Field control is not possible. Under severe conditions, resort to early harvesting is all that will save much of the crop. This measure is particularly urgent if the tobacco follows legumes rather than corn, as the tissue break-down advances more rapidly. The cause of this marked difference has not been established.

FRENCHING

Frenching may be confused with mosaic because of the somewhat similar shape of the leaves in both diseases. In severe cases the abnor-

mally numerous leaves become long and narrow, hence the common name "shoestring"; also, the leaves become much thickened and leathery. Unfavorable nutritional conditions rather than an organism are believed to cause the abnormal growth.

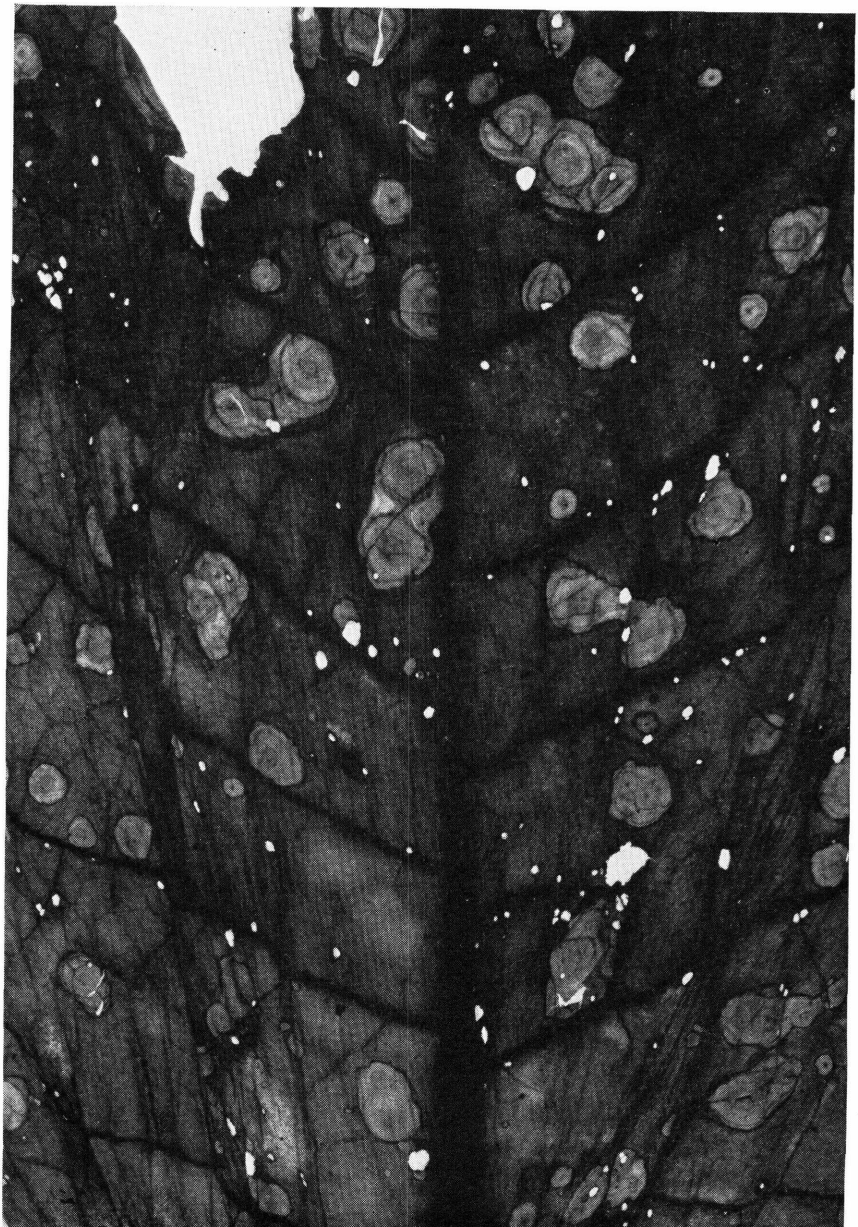

Figure 14.—Leaf showing wildfire lesions.

BLACK ROOT ROT

Black root rot is a disease that attacks tobacco during the first part of the growing season, causing the slow growth characteristic of many seedleaf strains. It is caused by a fungus [9] that attacks the young roots, turning them black and causing them to decay, thus stunting the plant. The organism is favored by low temperatures and neutral or slightly acid soils. Some recovery will occur as the soil temperature rises.

Because of the abundance of lime naturally present in the soils of this district, attempts to control soil acidity have been ineffective in retarding the incidence of black root rot. Liming for tobacco, however, should be avoided. The use of the more resistant strains has been successful to a considerable extent in overcoming the losses from the disease.

RING SPOT

Ring spot is a virus disease of rather infrequent occurrence and is not a serious malady. It can be identified by the characteristic small rings of white or pale-green tissue. Control measures for mosaic are applicable to this disease.

SHED BURN

Shed burn (house burn, pole rot) has been attributed to a number of semiparasitic and saprophitic organisms, all of which are abundantly present at all time (fig. 15). Saprophytes feed on dead organic matter; the parasites on living hosts. Wet-season crops seem to furnish a better medium for them than dry-season crops. The thick gummy leaves, low in soluble nitrogen and potash, which characterize tobacco grown in dry weather, are remarkably resistant to surface-growing organisms. Control is discussed in the section on curing.

STALK ROT AND OTHER ILLS

A few cases of stalk rot, wilt, and kindred ills have been noted, but their rarity is their notable feature.

MISCELLANEOUS INJURIES

Tobacco is easily damaged by hail, especially if fully grown. Although some damage occurs every year, hailstorms of wide extent are rare. Not so easily recognized, but of some importance, is wind damage, which frays and breaks the leaves. Sunscald usually appears when a bright day follows a period of dull, rainy weather. The cells of the surface layer (epidermis) are killed, turn white, and are almost transparent.

Following a protracted rainy period, wilting is common and may cause damage from which the plants do not recover. It is associated with the poor aeration of waterlogged soil.

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[9] *Thielaviopsis basicola.*

Lightning causes typical damage in an area restricted to a radius of 10 to 25 feet from the point of the stroke. The bark of the plants is often separated from the pith, and wilting soon follows.

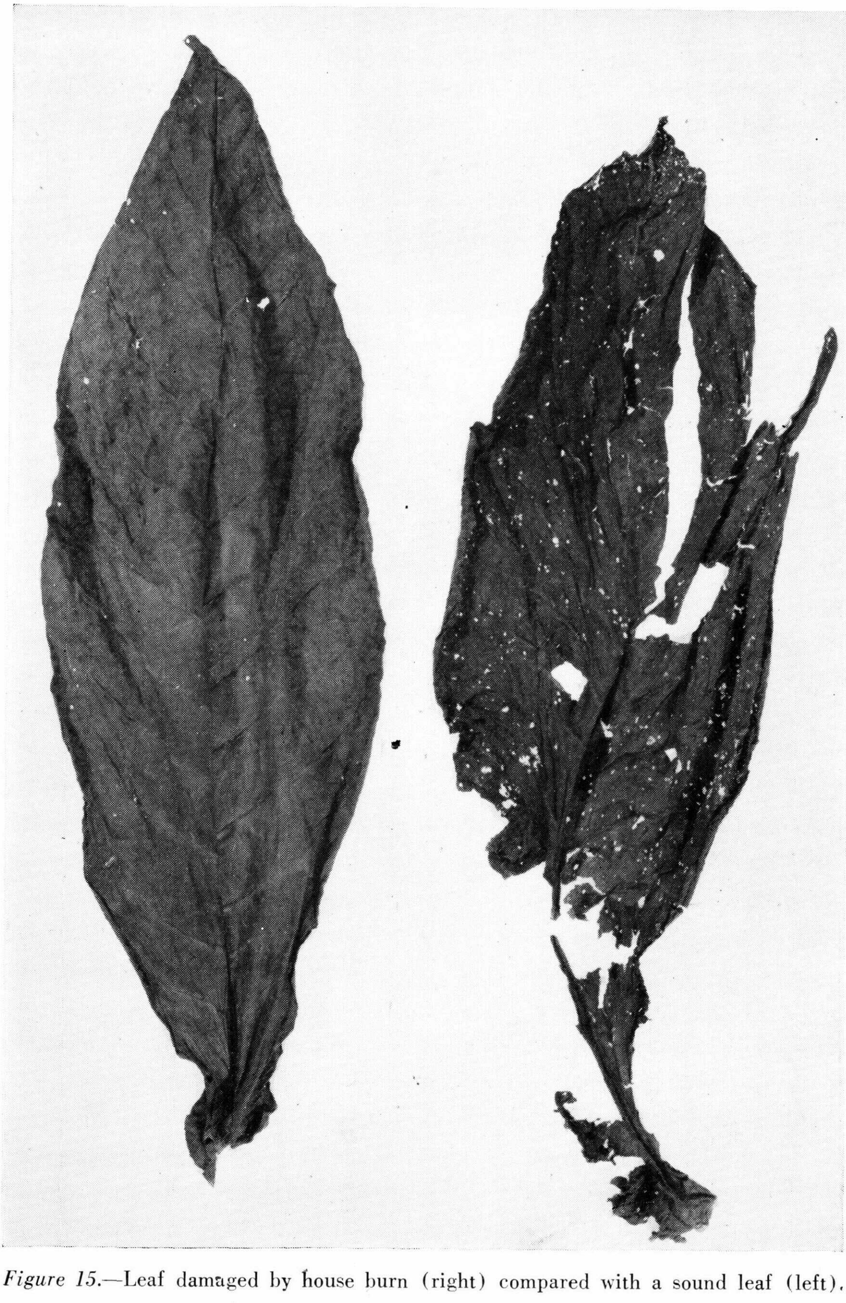

Figure 15.—Leaf damaged by house burn (right) compared with a sound leaf (left).

Fertilizer "burn" will occur when soluble fertilizer salts come in contact with any green plant tissue. In plant beds, leaf injury will follow application of nitrates that are not thoroughly washed off. Abnormally high applications of fertilizer to the beds kill the roots of seedlings and stunt the plants. In the field, actual contact with the fertilizer placed in a row will kill the plants. The upward movement of salts dissolved in the soil water also causes injury to both roots and crown, greatly stunting the plants until the salts are washed away by rains.

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